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THE JOURNAL OF PHILOSOPHY

VOL. XXVIII. No. 21: OCTOBER 8, 1931

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PUBLISHED FORTNIGHTLY
BY THE
JOURNAL OF PHILOSOPHY, INC.

THE JOURNAL OF PHILOSOPHY

All communications to the Editors should be addressed to Professor FREDERICK J. E. WOODBRIDGE, or Professor WENDELL T. BUSH, or Professor HERBERT W. SCHNEIDER, Columbia University, New York.

Subscriptions and advertisements should be sent to THE JOURNAL OF PHILOSOPHY, Prince and Lemon Streets, Lancaster, Pa., or 515 West 116th Street, New York. The annual subscription price (twenty-six numbers) is $4.00 and the charge for single numbers is 20 cents. Advertising rates will be forwarded on application.

THE JOURNAL OF PHILOSOPHY is owned by The Journal of Philosophy, Inc., 515 West 116th Street, New York, and published at Lancaster, Pa. President, Wendell T. Bush; Vice-President, Herbert W. Schneider; Treasurer, Frederick J. E. Woodbridge; Secretary, Iris W. Wilder.

Entered as second class matter, March 18, 1921, at the Post Office at Lancaster, Pa., under Act of Congress of March 3, 1879.

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A QUARTERLY MAGAZINE

Devoted to the Philosophy of Science

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339 East Chicago Avenue, Chicago, Illinois

Vol. XXVIII, No. 21. October 8, 1931

THE JOURNAL OF PHILOSOPHY

TYPES OF PHYSICAL DETERMINATION AND THE ACTIVITIES OF LIVING ORGANISMS

IT is now widely recognized that the modern scientific view of nature—the experienced externality which physical analysis resolves finally into electronic systems (matter) and radiation (with their interactions)—must be taken into account in the philosophical as well as in the purely scientific syntheses. The question of how far the graphic and mathematical models of present-day physics are to be regarded as provisional, and how far they give a true insight into the final constitution of natural reality, is not an easy one to answer. But it seems justified to assume that those factors which appear as fundamental constants in all natural processes, such as the velocity of light, the quantum constant, the electrostatic and gravitational constants, are true indicia of certain inherent and permanent features of the underlying reality. The external or physical aspects of nature would then furnish at least some clue to its inner or metaphysical constitution, although, as abstractions from an experience having many other aspects, they are not in themselves sufficient for a complete philosophical synthesis. A similar conclusion applies to biology; as an objective science it is physical; in the last analysis living organisms appear as constituted from the same ultimate elements (electrical units determined in their interaction by quantum transfers) as non-living systems. The biological systems are, however, peculiar among natural systems in certain very definite respects,—in their physico-chemical complexity,[1] their automatic integration of structure and activity, their self-preservative property, their maintenance through continual interchange with their surroundings. An additional and highly significant feature is the fact that each biological individual, especially of the higher types, shows typically a certain spontaneity or unpredictability of behavior not entirely referable to known factors present in the environment or in the organism itself. Some unanalyzed factor seems present which expresses itself in the unforeseen variations of individual behavior, and apparently also in the variability of heritable organization which has been regarded since Darwin as furnishing the

[1] In its physical constitution living matter exhibits a maximum of diversification within a minimum of volume. This feature is also characteristic of the chief biological compounds, the proteins which are the bearers of specificity.

material for evolution. Broadly speaking, the constancy of inorganic chemical compounds and reactions presents a definite contrast with the spontaneity or innate variability of living beings. The distinction is not an absolute one, since there is evolution in inorganic as well as in living nature, but it suggests the existence of two quite distinct types of causal determination in physical nature. Proceeding on such an hypothesis, we may identify the first of these in the familiar type of causation exemplified in large-scale inorganic processes, which show a definite and quantitative regularity now recognized as based on the general laws of thermodynamics. The second type is less readily characterized, but may be regarded as exhibiting itself (in part) in the variability, autonomy, and other more special features of vital activity; expressed briefly and antithetically, its source would appear to be *internal* rather than external.[1a] It seems reasonable to assume that the contrasted tendencies of living and lifeless matter have their counterpart in some fundamental difference in their dominant factors of determination—however clearly we may recognize the dependence of life on a non-living environment and the participation of purely physico-chemical components in the vital process itself.

This contrast appeals with special force to the scientific biologist, concerned as he usually is with the effort to analyze vital activities into simpler physico-chemical processes. Although as a rule he does not commit himself to a sharp distinction between physico-chemical and vital modes of causation, his efforts to refer the latter exclusively to the former have not met with unqualified success. The suspicion that the effort is misguided often intrudes, even though it is generally agreed that vitalistic hypotheses are scientifically inadmissible, since they appear to involve what Jennings calls experimental indeterminism[2] and so infringe the scientific rule of constancy. Nevertheless, none of the facts of living beings can be ignored by science; and it is possible to hold that the essential differences between living and non-living systems are more clearly defined in the higher than in the lower forms of life, in the latter of which the methods of physico-chemical analysis have, on the whole, been most successful. When we examine without prepossession the factors determining normal human behavior, and preferably its higher (e.g., ethical or creative) manifestations, we can not fail to be struck by the difference between those actions which are ex-

[1a] In a recent interesting paper ("Causal Determination; its Nature and Types," *Journal of Philosophical Studies*, Vol. V, 1930, p. 545) J. E. Turner also emphasizes the contrast between external and internal types of causation and discusses the possible rôle of the latter in vital phenomena. *Cf.* also my earlier paper in *Science*, Vol. 66 (1927), p. 139.

[2] *Cf.* H. S. Jennings, "Mechanism and Vitalism," *Philosophical Review*, Vol. XXVII (1918), p. 577.

ternally compelled or enforced by the physical needs of the body, and those which are determined—or at least seem to our intuition to be determined—from within, especially voluntary action. There seems to be an element of irreducibility in this difference, suggesting the existence of some radical disparity between the externally determined and in the internally determined types of action; and we are led to seek in physical nature for evidence of a distinction or dualism of a similar kind.

Recently the element of unpredictability in the single electron event, i.e., non-specifiability of momentum or position within a range fixed by the quantum constant (the principle of indeterminacy of Heisenberg), has often been pointed to as evidence of the existence of an inner freedom or non-determination in single atomic processes.[3] To support belief in freedom of the will on such grounds is, however, scarcely justified (whatever other grounds there may be for this belief); all that the physical evidence shows is that the conditions of determination are different in the intra-atomic events which determine the transfer of physical influence between single atomic centers from what they are in large-scale or mechanical events. Stability, of whatever kind, implies determination; without determination there would be chaos, which is far from being the fact; and at present physical investigation is actively engaged in defining in exact terms—very different from the older mechanical models, it is true—the constants of the experimentally accessible phenomena. There is no evidence of exception here to the principle of the interdependence of stability and change which runs through all natural existence; and uniformly acting determinative factors (natural constants) would appear, simply as an inference from experiment, to be as much a part of quantum events as of any other natural processes.

Nevertheless, a sharp distinction is drawn in practice between the two types of physical determination relating respectively to events on the sub-atomic or electronic scale and to the large-scale events of ordinary perception. The distinction is that between quantum mechanics and large-scale mechanics; and we have the problem of the manner in which the small-scale or electronic events, conditioned by quantum processes, are related to or determinative of the large-scale events to which the thermodynamic laws apply. In the latter case we are dealing with collective effects, and apparently one solution of problems of this type is furnished by the methods of statistical mechanics. But other modes of transition from the intra-atomic to the large-scale types of causation are possible; and there is reason to believe that in living organisms—with

[3] *Cf.* Eddington, Jeans, and other writers on the borderline between science and philosophy.

their protoplasmic organization constructed on the microscopic or ultra-microscopic scale—the interaction between the two is of a more special kind, based ultimately on certain features of electro-chemical action. Thus the physiological evidence shows that in higher animals motor action is mainly controlled by the transmission of waves of electro-chemical change along the structural surfaces of the protoplasmic units (nerves and other conducting elements). Typically the origination of these waves is in the minute structural elements of the central nervous system or its receptors. The energy required to initiate a transmitted disturbance of this kind may be very small; thus only a few quanta of radiant energy (possibly not more than one for each retinal element involved) are sufficient to excite a visual sensation and so elicit an extensive physiological response.[3a] What is especially interesting is that the spreading and branching type of distribution characteristic of this transmission involves in effect an amplification of the initiating disturbance, which may thus activate a large physiological field having a highly special kind of activity and interconnection. A local change occurring in a minute, conceivably even ultra-microscopic structural unit, may thus express or register its special peculiarities (e.g., of rhythm, amplitude, directive action) in the dependent large-scale physiological process. In this manner events originating under the conditions peculiar to individual atoms may have a determinative influence on the large-scale of organic action.[4] It is recognized that the *visible* activities of living beings, since they are, physically considered, large-scale phenomena, conform to the usual conditions of classical physics, i.e., their mechanical, chemical, energetic, and other characters show no conflict with the thermodynamic or other laws characteristic of such phenomena. Recent research has amply shown that physical chemistry applies to living organisms with the same exactitude as to non-living systems. But there is equally conclusive evidence that the special or detailed character of vital action is to be referred ultimately to the fineness of structural differentiation characteristic of living matter.[5] Transmission of influence from events occurring in minute areas of organized structure where the conditions of determination are of the small-scale or intra-atomic type must be recognized as an essential, perhaps the

[3a] Excitation by a single quantum would be excitation by change in a single molecule, according to Einstein's law of photochemical equivalence.

[4] For a fuller discussion of this possibility *cf.* my paper, "Physical Indeterminism and Vital Action," *Science*, Vol. 66 (1927), p. 139.

[5] Thus the estimated maximum diameter of the *genes*, the interchangeable chromosomal units in the nucleus of a germ cell, which, according to the very conclusive evidence of experimental genetics, determine the phenomena of Mendelian inheritance, is of the order of 50$\mu\mu$ (millionths of a millimeter).

chief, distinguishing feature of vital processes. An important part of vital control is, therefore, to be assigned to such events.

In the present paper I propose to examine briefly some general implications of the hypothesis that the special directive or controlling factors in living organisms (those which determine their characteristic individuality of action) have their origin in ultra-microscopic or intra-atomic events where the general laws of energetics (now recognized as statistical in their origin) do not apply. It is to be emphasized that in the type of determination thus presumed there is no question of an infringement of large-scale conditions; it is simply that the conditions and processes in the small-scale phenomena have laws or constants of a different kind. In these processes the factors of individual or internal (intra-atomic), as distinguished from external, determination assume chief importance. These laws may be characterized as the laws of individual or internally determined atomic action,[6] and are here contrasted with these of large-scale action, in which the course of events is controlled by the collective conditions defined by the general laws of thermodynamics.

The essential nature of the distinction between an internally determined and an externally determined atomic action may be illustrated in a general manner as follows. Consider a single atomic unit, some indivisible or permanent center of physical existence or action, such as an electron. Such a unit is a store of energy (i.e., actual or potential action); physically this means that under circumstances the unit may transfer a portion of its energy to some other unit (or units) in its environment and so transmit influence or activity. Any such single transmission has a directive character, since it occurs between definite units having definite position. If the unit be conceived as non-composite, i.e., as having no internal differentiation of any kind, such a transmitted action, if determined solely from within, could equally well be in *any* direction. I.e., no *internal* impulse to action would necessarily act in any one direction rather than another, since such a directive action would imply the existence of one part acting on another along definite lines of contact or interconnection (vector lines),[6a] and such parts are absent. We may thus conceive of the possibility of an internally originating

[6] It is to be noted again that no absolute distinction is implied here. In any single natural event, we may distinguish between *internal* determinative factors, those peculiar to the entity undergoing change, and *external* factors, those which affect the action of the entity by impingement or entrance from outside. For example, a chlorine atom behaves differently in the presence of a hydrogen atom from a nitrogen atom. And the same is true of the most highly complex processes, such as organic inheritance, where the distinction between external and internal determinative factors is recognized by all biologists.

[6a] That is, according to the classical laws of motion.

directive action which is quite independent of the classical laws of motion or energy. The latter, it will be remembered, relate solely to the behavior of systems consisting of many atomic units which interact with one another. If we consider a single atom uninfluenced by others (i.e., from outside), it seems clear that a quantum transfer *from* this atom might be in any direction (i.e., *to* any other atom) without infringement of these laws.[7] Such an illustration indicates the nature of the contrast to which attention is directed in this paragraph. According to classical principles (derived, historically, from the study of large-scale phenomena) the complete determination of the direction of a physical action would be possible only in systems having parts which interact along lines of union, contact, or other form of connection, i.e., transmission of a spatially definite or canalized type would be required. Directive action in the large-scale world has experimentally just these characters—which, however, are apparently not to be attributed (at least in the same sense) to the single intra-atomic events.

Is it legitimate to conclude that determinism of the strict physical type applies only to effects depending on the *interaction* between atomic units and not to the internally determined action of the units themselves? Does the experimental evidence justify such a conclusion? The question can not be answered definitely on the basis of physical evidence alone. The fact to be emphasized, however, is that intra-atomic action can be influenced experimentally (i.e., from outside) only to a limited degree.[8] All the physical evidence indicates that the intra-atomic stores of energy are of a vastly greater order of magnitude than the energy which is transferred in the ordinary physical events dependent on interaction between atoms. This would imply that each atomic unit has an inner activity (= energy) which is very largely, *although not completely,* independent of outside influence, in addition to an experimentally demonstrable activity which is wholly determined by outside influence—i.e., by interatomic action associated with the interchange of energy quanta.[9] We may then describe the atomic unit

[7] A concrete illustration of such conditions would be a radium atom, the rate and character of whose disintegration are determined by internal (intra-atomic) factors, which are apparently not influenceable by external conditions (i.e., experimentally).

[8] Examples of such influence are seen in radiation and the Zeeman effect; these effects leave the atomic system intact. There is also the case of atomic disintegration through bombardment with alpha particles (Rutherford).

[9] Just how physical atomism is to be related to the monadic conceptions of general philosophy is a difficult problem. It may be suggested, however, that if the atom is to be regarded as the physical sign or representative of a monad (of any type), the latter could scarcely be "windowless" in the Leibnitzian sense, but its isolation would be incomplete. Since transmission between atomic units is physically a fact, although involving only a minute portion

as having, first, an internally determined or autonomic activity and, second, an externally determined activity depending upon the reception of quanta from other units. It is interesting, if somewhat disconcerting, to note that activity of the former type (if purely internal or self-contained) would be closed to physical (external) observation, since any such observation involves an effect on the sense organs, i.e., a transfer of influence between atomic systems.[9a]

To summarize: determinism of the traditional physical type (i.e., experimentally demonstrable or externally observable) would, according to this view, apply mainly or exclusively to the interaction *between* atomic units, or to mass effects depending on such interaction. Each atomic unit would then have an autonomous or internally conditioned activity of its own, as well as an activity determined by external influence. The former type of activity would, if it could be observed, appear as the free[10] (in the sense of externally undetermined) component of the action under consideration, the latter as the determined component. Under circumstances (not physically defined at present) the former might eventuate in an externally effective action. The initiation of the action would then be of the former ("free") type; the succeeding course of the action, as physically observable, of the latter (determined) type. All actions of the latter type would, viewed externally, have the definite or determinate character of large-scale physical action, because of the fixed conditions controlling the interaction and transfer of energy between atomic units. In the summation of many such single atomic actions, as in physical effects on the normal scale of perception, the general statistical laws of thermodynamics would hold. These latter constitute the conditions which make possible regularity or fixed determination of action on the large scale. As is well recognized in physics, the stability of the general external physical conditions, such as temperature, pressure, potential, depend on these conditions, from which therefore are derived the constancy

of the inner energy of the unit, the idea of complete monadic isolation and its corollary, the principle of preëstablished harmony, would seem to be inconsistent with the modern scientific view of nature. In fact, these and other elements of Leibnitz's doctrine (derivable largely from the historical conditions under which he wrote) require amendment in the light of modern knowledge. What is important is that the intrinsic or inalienable energy (= reality) of the physical monad or atom is recognized by physics as very large in comparison with that which participates in interatomic action. A relation can be seen here to the hypothetical character of closed or self-contained individuality ascribed to the philosophical monad.

[9a] Compare Bradley: "the world we see is probably a very small part of the reality" (*Appearance and Reality*, p. 199).

[10] I use the term "free" simply to point a contrast between the two types of determinism (which I designate below as primary and secondary), and not at all to imply an absence of determination of some kind.

and dependability (i.e., the definite, regular, and repetitive features) of the observed events, processes, and cycles of external nature.

The Heisenberg principle of indeterminacy states simply that in the single electron event position and velocity are not simultaneously specifiable. This follows from the discontinuous or packet-like character of the quantum transfer and the physical conditions of observation. Yet something corresponding to motion has to be assumed, and motion always means spatial transfer of mass or energy in a definite direction.[11] Experimentally, however, a quantum transfer does exhibit a directive character, subject to at least a certain measure of external influence. This is seen, for example, in the interaction of radiation and electrons; thus the electron tracks shown by the Wilson cloud method exhibit a definite trend in a direction which is related to the direction of incidence of the radiation.[12] The determination of the single atomic event by the external condition is, however, not complete (an element of probability enters), although in the summation of many such events, i.e., in large-scale or mass effects, the determinative feature becomes the controlling one. The existence of such directive behavior in the single unit is of fundamental importance, and may be regarded as evidence of a certain inner differentiation in the electron; this is presumably provided for, theoretically, in the vibratory or wave conception of electronic constitution.[12a]

We may now briefly consider certain other more general characteristics of external nature which also indicate the existence of an internal as distinguished from an external type of determination. Of first importance—since they are the conditions of all large-scale action—are the laws governing the behavior of energy in the external world, especially the principle of dissipation known as the second law of thermodynamics. In its simplest aspect, this principle is best illustrated by the behavior of gases. Gases are[13] assemblages of numerous minute non-coherent particles in rapid random motion. In such an assemblage, conceived as isolated in space, an indefinite degree of *divergent* motion is possible, but not of convergent motion,

[11] *Cf.* A. N. Whitehead: "Direction is not concerned with what is merely at that point" (*Principles of Natural Knowledge*, p. 24); i.e., it requires reference to external conditions.

[12] For a brief account *cf.* the review by A. H. Compton, "The Corpuscular Properties of Light," *Physical Review Supplement*, Vol. 1 (1929), p. 74. A fuller treatment of the subject is contained in the same author's book, *X-rays and Electrons*, New York, Van Nostrand Co., 1926.

[12a] Here, as in other departments of science, the problem is to make the conceptualization as consistent as possible (or practicable) with the experimental fact, a problem which must be left to the specialists in this field.

[13] "Are," i.e., behave experimentally as if they were; the particles are conceived as solid, i.e., as holding their individuality or resisting interpenetration.

simply because any molecule approaching a central region inevitably encounters other molecules, i.e., space which is already occupied. Hence those impacts whose resultants are centrally directed have on the whole less effect in causing motion than those with peripherally directed resultants. Motion in the one direction encounters steadily increasing resistance, in the other steadily decreasing resistance. The distinction between *inside* and *outside*, corresponding to that between occupied and unoccupied space, thus lies at the basis of the thermal course of events and determines in the long run a general flow of energy toward the external regions of the cosmos.[14] What applies to the kinetic or mechanical transfer of energy—the kind of interatomic influence assumed in the classical gas model—applies ultimately also to the transfers of energy in other large-scale processes, since the thermal moment is always present in molecular events. The tendency just described is illustrative of a general cosmic tendency which automatically would proceed (assuming the universality of the laws of energy) until the whole universe is in thermal equilibrium (the so-called "heat-death" of Clausius). The unidirectional character of the time-flow in conscious experience is in fact referred by many physicists to this condition; i.e., time as experienced (Bergson's duration) is ultimately an expression of the existence of the second law;[15] the irreversibility of the general course of events (a correlate of the irreversibility of time) is evidently a corollary of the irreversibility of the general thermal process.

Hence arises the impression of impossibility which is so strong when we witness a reversed cinema reel, since on a sufficiently magnified scale such a picture would show the ultimate particles of matter as moving spontaneously against resistance, i.e., toward occupied instead of unoccupied space,—very much as if the mutual repulsion of the electrons *decreased* (instead of increasing) with the square of their distance apart. Such behavior is the reverse of our normal experience of nature.[15a]

[14] Of course the outflow of energy from any one local region may be compensated or over-compensated by inflow from some other (or others) external to it; i.e., there may be thermal equilibrium, or the first region may increase its energy at the expense of the others. What the theory asserts is that when all the interacting regions are considered together, the total effect is decrease of available and increase of unavailable energy (i.e., of entropy).

[15] *Cf.* W. S. Franklin, "The Quantum Puzzle and Time," *Science*, Vol. 60 (1924), p. 258; e.g., "the law of increase of entropy and our intuition of time unquestionably grow out of the same condition in nature . . ." (p. 260); also, "Entropy and Time," *Physical Review*, Vol. 30 (1910), p. 776; also G. N. Lewis, *The Anatomy of Science*, Yale University Press, 1926; and *Science*, Vol. 71 (1930), p. 569 ("The Symmetry of Time in Physics"); Norman Campbell, "Time and Chance," *Philosophical Magazine*, 1926, Series 7, Vol. 1, p. 1106; Eddington, *Nature of the Physical World*, p. 68, and others.

[15a] The assumption, sometimes made in physics, that the fundamental con-

Yet the centralization of energy in innumerable spatially discrete atomic units is one of the most firmly based of experimental facts. Atomism is fundamental in the structure of nature. This condition exists—whatever its origin is or may have been. Physical science shows a vast surplus of energy concentrated in the innumerable localized units (ultimately positive and negative electrons) which form the elementary components of matter. The radiant energy which proceeds outward from such units and the energy expressing itself in the other observable forms of physical change are relatively a very small part of the total energy of the cosmos.[16] Thermodynamics, while describing accurately the conditions of transfer of energy between material systems, has no reference to the problem of how energy came to be thus centralized in the atomic units. Its deductions have reference to a world already given as having an atomic constitution. According to the thermodynamic conception the prevailing direction of change in natural processes is opposed to the local concentration of energy, i.e., the universal rule is the dissipation described by the second law. Observation shows, however, that the energy of radiation always originates in intra-atomic changes,—e.g., according to the Bohr model, in the transition from one stationary state to another; atomic disintegration or transmutation is another recognized source. On the present physical view, therefore, the intra-atomic energy represents the ultimate source of the energy appearing in normal physical processes. Apparently, the only physically adequate source of solar radiation (from which comes most of the energy of terrestrial events) is the transformation of intra-atomic energy, occurring concomitantly with atomic degradation and loss of mass by radiation.[17] Thus the

ditions of motion or of energy-transfer in nature are *symmetrical* (involving the conception of a symmetrical instead of unidirectional "time") must be regarded as purely ideal in character. Such conditions can not exist in actual nature, because of the inevitable asymmetry from central to peripheral. I.e., convergence, but not divergence, of energy is restricted in the manner just indicated. It may be noted also that the recent conception of the "expanding universe" (a deduction from the uniform and large Doppler shift in the radiation from distant star-systems) implies also a unidirectional time-flow. A generally divergent flow of matter in the cosmos would seem to be indicated—assuming the validity of the physical interpretation.

[16] Compare the remarks of the Mathematical Physicist in J. W. N. Sullivan's interesting book, *Three Men Discuss Relativity*, New York, 1926, p. 75.

[17] Similarly, the general cosmic radiation of interstellar space is regarded by Millikan as having its chief origin possibly from the formation of helium from hydrogen, a process involving loss of mass (*Cf.* his recent address in *Science*, Vol. 73 (1931), p. 1.) Jeans supposes an occasional annihilation of atoms by the union of positive and negative electrons, with a corresponding dissipation of short-wave radiation (*Cf. Nature*, Vol. 128, 1931, p. 103).

continual loss of mass by the sun to surrounding space is estimated as approximately 4,000,000 tons per second.[18]

When we consider the Einsteinian identification of matter with energy, together with the recognized fact that radiant energy originates from changes in electronic systems, the inference seems unavoidable that energy in some way must enter, or has entered, the cosmos at the innumerable discrete atomic points, and spreads outward from these. In so doing, it manifests itself in the various forms of physical change. The basic determinative factor or agency in nature would thus be one which expresses (or has expressed) itself in the centralization of energy or action in the spatially discrete and mutually exclusive units or atomic foci which by their aggregation form the observed material systems. There is at present no scientific account of any such factor; i.e., no physical process is known which can be conceived as assembling and concentrating from some outside source the vast stores of intra-atomic energy. Similarly, we have no basis for an answer to the question whether this entrance of energy into the cosmos at the atomic points is a continuous process, or whether it is to be conceived as having happened once for all at some definite time in the past. Could there have been a certain period of creation—conceivably assignable by some process of extrapolation, based on estimates of the magnitude and rate of change of the present entropy of the universe—at which the universe started? Those who hold that a heat-death is inevitable (like Sir James Jeans) might well make such a calculation.[19] Or is energy entering the universe more or less continually from some extraneous source which in some unknown way asserts or manifests itself at the atomic points? The latter conception would seem to conflict with the law of conservation and, in fact, leads to difficulties. An alternative view would be that the energy dissipated or dispersed in radiation is, so to speak, re-collected and enters physical nature again at the atomic points. A re-entrant distribution of energy would be implied by such an hypothesis, i.e., something analogous to a continuous circulation of some kind. In a universe having a multi-dimensional constitution (in the geometric sense) such a process might be possible. The theory that the universe is inevitably approaching a state of uniform potential, with consequent absence of change, has always had in it an element of the incredible; it is, in fact, an example of extrapolation from the data of thermodynamics considered abstractly or in isolation from other data. The

[18] *Cf. e.g.*, H. Jeffreys, *The Future of the Earth*, New York, 1929; Jeans, *The Mysterious Universe.*

[19] *Cf.* Eddington's recent address before the Mathematical Association, "The End of the World from the Standpoint of Mathematical Physics," *Nature*, Vol. 127 (1931), p. 447.

alternative view that a balance is somehow maintained in the cosmos between the dissipation and the re-entry of energy would seem on general grounds to be more credible; but it has, so far as I know, no definite scientific basis at present.[19a]

If we regard the centralized or atomic energy of the cosmos as having had (or as having) some extraneous source, we seem compelled to recognize the existence of two distinct types of physical determination in nature. One of these is internally directed, issuing toward or into the numerous spatially discrete local regions or focal points which appear to science as atoms or electrons. For purposes of designation, we may characterize this type as *primary*. The other, externally directed, is dependent on the transfer of quanta between such foci and exhibits itself ultimately in the physical causation of everyday experience. The latter type appears as the derivative of the former (i.e., as *secondary*) and manifests itself in the various events to which the classical laws of energy apply. Until recent times scientific investigation has had reference almost exclusively to this type of determination. Little is known as to the physical conditions governing the transitions between the two types. That such conditions exist and have constant or scientifically definable characteristics may be assumed both from experimental evidence and on general philosophical grounds. As already remarked, the problem is not solved by characterizing certain events (single quantum events) as indeterminate, free or arbitrary—the snare of verbalism is to be avoided—but must be recognized as one to be approached like other scientific problems by methods of systematic investigation and criticism.

With regard to the special problems of biology, the question is: What part, if any, can be assigned to the primary or internally originating factors in the determination of the activities of the living organism? Only a tentative answer can be given at present. It is sufficient to recognize that of the great reservoir of energy present in the cosmos by far the greater part is intra-atomic. Just how this energy asserts itself in the behavior of the individual atomic systems is the essential problem to be solved. I have already referred to the hypothesis that single intra-atomic events may conceivably govern large-scale events in living organisms by virtue of the properties of transmission combined with amplification which are so characteristic of irritable living matter. The control of the initiatory intra-atomic events would, in this hypothesis, appear to be an essential condition of vital control; i.e., the factors of intra-

[19a] In a paper read last June before the American Association for the Advancement of Science, Professor Richard Tolman discusses such possibilities from the standpoint of relativity theory. For a brief summary *cf. Science*, June 26, 1931, Supplement, p. 10.

atomic determination would become factors in vital activity. The question is how we are to conceive these intra-atomic controlling factors. Nothing is to be gained by ignoring or denying their existence. If we identify reality [20] with energy (activity) we must conclude that the portion of reality which can be externally observed, i.e., which is capable of affecting the sense organs at any one time, is only a small fraction of the whole. However valuable the methods of classical physics and chemistry may be in physiology, they require to be supplemented by other methods which will take into account the other types of determination now recognized as occurring in nature. I am confident that the present situation in reference to the fundamental theoretical problems of biology (just now largely one of impasse) [21] will clarify itself with the progress of investigation. As an analogy we have only to recall the recent transformation in the theory of the origin of solar and stellar energy. Just as the recognition of the new sources of physical determination in the intra-atomic processes has brought increased consistency and scope to the science of astro-physics and has effectually supplemented the older contraction theory of Helmholtz and Kelvin, so we may look for further expansion, based largely on the recent transformation in physics, in the fundamental conceptions of biology.[22] It is possible also that on the theoretical side biological studies may assume a more philosophical character, i.e., may have a closer reference to other fields of experience than the objectively observable processes of organisms. Light may be thrown on the fundamental problems by a correlation or synthesis of the data of psychology with those of the objective biological sciences. In any case, rigor in the determination of fact and in criticism ("the soul of science") must be the mainstay of all such investigation.

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[20] I.e., physical reality; as to the larger question of reality in general nothing is said here. It may be assumed, however, that a moment of physical energy (actual or potential physical activity) is present in whatever is real. To identify a reality completely with any one of its abstracted components is, of course, inadmissible.

[21] *Cf.* for example, the recent criticisms of J. H. Woodger (*Biological Principles*, New York, 1929); E. Rignano (many papers in *Scientia*, of which the most recent, p. 122, November, 1929, is an epitome); Joseph Needham (*The Sceptical Biologist*, New York, 1930).

[22] I am simply indicating that there may be within the single atom reservoirs of biological determination, which it will be the problem of future science to define.

ARTIST, PHILOSOPHER, AND THE IDEAL SOCIETY

WHEN the idea of this discussion first came to me, it took the form of a contrast between two ways of thinking—the artist's and the philosopher's. I had just finished for the first time Romain Rolland's great novel of the romantic spirit, *Jean-Christophe*. Something in it, perhaps Rolland's profound social idealism, suggested a re-reading of *The Republic*. I can not say what led me to connect the social philosophies of the two books, nor shall I attempt to justify the comparison.

And yet there is something fundamentally alike in the two men —Plato and Rolland. Both have a tremendous passion for righteous society. Both desire a better world for themselves and their fellows. Both look eagerly forward to the creation of some more perfect community. Each succeeds—Plato explicitly, Rolland by the subtle devices of the artist—in projecting a vision of what that ideal society is to be. Though Plato conceives it as an embodiment of Justice, and Rolland as an embodiment of Universal Brotherhood; though life in it is more creative and less contemplative for Rolland than for Plato; the differences, fundamental as they may be, need not detain us here. It is enough that each found his vision straying from the fragmentary and imperfect social order of his own day to an ideal community that might be. That makes them brother seers.

But from this point their thought diverges. When it comes to the meaning that shall be attached to an existing social order in the light of its relation to that which is ideal, philosopher and artist look with different eyes. The one observes the city-states of his day and finds them but gauche and imperfect replicas of the ideal, distorted by alien and irrational elements. The other looks upon Europe of the nineteenth century and discovers unique and significant values, even in those features which he hates and wishes most to obliterate. For the one the projected ideal is the source of societal meanings and values and the very criterion by which existing societies are to be judged, even though its achievement in the actual may be forever impossible. For the other, the ideal is a shibboleth of loyalty, a plan for which to work, a dream which in its realization will bring new problems and but partially free mankind from the drags and hindrances that encumber the present order. There is meat enough in this contrast for much profitable chewing of a philosophical sort. For the explanation of this difference lies deeper than time or place or circumstance. Undoubtedly the France of Romain Rolland was in certain definite respects a better (or a worse) kind of society than Athens or Syracuse. And these concrete differences are echoed in the two men, in

the problems which they envisaged and in the solutions they proposed. But by and large the factors which disrupted Athenian and late nineteenth-century civilizations were essentially the same. Plato and Rolland faced problems in social theory that were largely identical. We must look beneath the historical occasion for the underlying method of analysis used by each, if we are to understand their divergent interpretations of the relation between actual communities and the ideal.

Let us take the philosopher first. The path is familiar and dear. After the courteous preliminaries of philosophic discourse are satisfied and the tortuous path to the main problem is traversed, the exposition begins when Plato lays down a major premise, a first principle so axiomatic with him that it scarcely needed proof. The State exists, and can exist only when every citizen does that and only that for which he is best fitted. This premise, in turn, rests upon a deep-seated bias, Plato's ingrained preference for the harmoniously ordered and intelligent life. The supremacy of this way of life above all others is taken for granted, in the primitive and absolute sense of the phrase. That is, the life of reason is justified by Plato only in terms and arguments that tacitly assume its own supreme value.

Upon this basis the ideal State is constructed by the process of syllogistic deduction. The argument runs from premise and premise to conclusion in descending series until the outlines of the ideal community emerge and begin to take on the flesh and blood of actual civic life. A city rises into being before our eyes; citizens are created; institutions are set in motion; the State is a going concern. Everything develops according to the rules of the formal processes. Practical details spring from abstract premises and multiply as if by magic. If our State is to be such and such, it must have so and so: workers, cobblers, husbandmen, merchants, guardians, legislators. It must carry on such and such: education, diplomacy, propaganda, war, city planning, and a hundred other common-sense activities.

The way in which these actualities of civic life blossom into being upon the pages of *The Republic* is from the standpoint of logic the most remarkable aspect of the treatise. Supposedly they are inferred into existence. And yet the mere weight of inference is not sufficient to account for the impact which they make upon the reader, nor for the way in which they reinforce the premises from which they are presumably derived. As a matter of fact, the details are not new. We have met them before, not as end-conclusions to a system of sorites, but as existing conditions in our own ill-organized and imperfect society. Cobblers, horsemen, poets, soldiers, philosophers; birth control, communal dining rooms, education for

women, censorship of art—all of these have been encountered in the course of experience, before we ever knew that they might emerge from a course of dialectic reasoning. This is the reason that when they appear in *The Republic* they carry more than inferential validity. Innocent products of ideas they seem, but they bring with them the authority over the reason which actual existence gives. We are irresistibly pushed to the conclusion: if the ideal State can cause these common-sense regulations and activities to spring into being, it must be the ideal we are looking for. The premise upon which it is based must be valid. And the present order must have no other meaning than to point in its direction.

How subtly Plato relies upon this ingenious device, by which you (not he) whole-heartedly assent to the many details and on the strength of that assent inadvertently affirm the preceding principles! How often he calls forth involuntary admiration for his city in heaven by compelling your assent to the practical wisdom of its detailed structure. Call it, if you please, the fallacy of affirming the consequent. That is the way with the architects of a new Jerusalem. The plan is of heaven; the sticks and stones, the beams and mortar are of the earth. Yet earth looks heavenward and humbly accepts from heaven's hand the benediction of approval which it all unconsciously was the first to bestow.

It is apparent, then, that a social philosopher of Plato's sort has to substantiate his vision of what society ought to be by reference to those bits of concrete life which he has already chosen to incorporate into that ideal. The standard by which what is is judged is itself derived from actual experience. In fact, the ideal is more nearly a reflection of the social order in which the philosopher actually lives than it is prophetic of the social order which might come into existence if forces were set in motion to realize the ideal. Is it not pretty largely a compound of those intermittent experiences from which one has derived satisfaction and those yearned-after experiences which, seen in others, one covets for onself, a compound from which have been removed the discordant elements which at present mar an otherwise complete happiness? The pleasure-pain principle functions in the formation of social utopias, too. Their aims, contrary to the usual impression, are severely practical.[1]

[1] We are spectators of a contemporary example.

The ideal towards which the communist states of Soviet Russia are working is confessedly a more efficiently planned and more righteously administered United States of America, just as the ideal of the French revolutionaries was a duplicate of free England. The implication of this statement is not what the casual reader might infer. There is a fundamental difference between stumbling upon a social order like ours and consciously planning to bring that same order to pass in a form that will administer to the highest needs of all men.

In no philosophical writing are these considerations more apparent than in *The Republic,* for which, by the way, we have to thank the engaging philosophical frankness of Plato. What is the State but the philosophical life writ large? It, of all lives, is alone wholly desirable. It alone possesses real meaning, and is blessed of the gods. To its perpetuation and enrichment all other lives should be bent. Can one fail to perceive beneath the premise that each man shall do what he is best fitted for, the more subtle assumption that each man shall do what the philosopher thinks he is best fitted for—in order that the philosopher may do what he chooses. In the end we return to Thrasymachus (as Woodbridge has so acutely pointed out in his *Son of Apollo*). Justice is the rule of the powerful, even though it be the power of clear insight and a trained intelligence.

I am unfair. The excuse for Plato is his inability to imagine a man who is not potentially a philosopher. The evidence for this limitation strikes one on every page. Men will be amenable to the guidance of a State in which order reigns and intelligence alone is cultivated. Even the dirt laborer can be trained to discipline and control his passions as the philosopher does, despite his inability to comprehend the end in view. By gentle methods he will be taught not to covet the rich fulfillments of life reserved for those worthy of enjoying them; he shall find in his rigorous life as a workman sufficient vicarious satisfaction to resign himself to the fate of his position, *like a philosopher.* Compulsion by brute force or economic pressure will not be necessary. For even the natural man can not hold out against the sweet reasonableness of a beautifully ordered state. In this connection it is interesting to note that the pictures of the promised land which the Hebrew prophets were forever painting never failed to contain one detail. The heathen, forbidden to enter, are not forgotten. They look up from below, hopelessly sighing for the joys which they are doomed to contemplate but not to experience. They resign themselves to their fate, and their resignation is so bitter because they know, as only those *in bliss* can know, what the happiness is that passes them by. They are not heathen, but not-Hebrews.

I have spent too much time with Plato. It has not been too foolishly squandered if the logical precariousness of defining the social object in terms of an ideal essence from which existing societies derive meaning, but which is itself supposedly independent of implication in existing orders, is apparent.

What has Rolland to offer instead? Like Plato, he too would wish the life of intelligent order and harmonious endeavor to prevail. Even more sensitive is he to the nice equilibrium which a stable family society makes possible, and which holds in precarious

suspense the devastating forces of passion and unreason—not without occasional resort to war, as Rolland hints in more than one passage. It is perhaps because this ideal is so necessary a part of his make-up that he incorporates it in Olivier, the friend of Jean-Christophe, and then with the exquisite delicacy of a man torturing himself depicts its effects upon character when external facts by some luck refuse to support that ideal. Olivier embodies the Platonic spirit. Life for him is conceived in terms of a few simple propositions—love of family, wife, child; recognition from fellowmen which is ability's just due; respect from the less worthy; a sensible, unimpassioned pursuit of the quieter pleasures. When the carefully-built social structures that surrounded and sustained this set of propositions were swept away by a series of tragic but not unusual disasters, the syllogisms (the inner neural symbols of the outer institutions) in terms of which life was ordered and possessed meaning could not be completed. The premises hung in midair; they elicited no conclusions—for the conclusions demanded were concrete events in the actual world; and life had tragically arranged itself for the moment so that these events were impossible. There was nothing to do but die. Olivier enlists in a futile street revolt to bring into existence a shadow of his ideal, and, in the petty scuffle that ensued, is accidentally killed.

Are we to see in Olivier the futility which the artist-mind attributes to a syllogistic reconstruction of the meaning of existing institutions and activities on the basis of some hypothetical definition of the social object? Yes; if at the same time we do not neglect to notice the interpretation which the artist does give to the social scene. His way is the method of creative art, by which the significance of any experience to itself is made palpable through an art object. Jean-Christophe, the hero of the novel, is an embodiment of this attitude. He, too, has his fierce, logical idealisms, his premises and conclusions, in terms of which he evaluates and condemns. But, with Christophe, life precedes formulations and continues to dominate them. Vital forces rage within; no set of principles ever completely masters them. Yet art can hold the reins. Christophe finds, when still a boy, that he can tame the most obstinate impulse, the most irrational drive, the darkest mood, if he will allow it to incubate its own meaning in his inner self, and then let that meaning issue forth in music. So he goes through life, a lawless being—touching, tasting, mastering, bending all things to the will of his own integrity, bending always to the will of brute facts. When externals come tumbling down to wreck his plans and ideals, he takes what is left and in fierce joy builds a new life.

An artist-mind of this sort sees differently than the philosopher,

as it moves out to interpret the social order. It can storm, pass judgment, censure, and prophesy. It can revolt. There were times when, if Christophe had had his way, like the Lord Jehovah he would have wiped all mankind from the face of the earth (himself included) and started anew. But always the practical reason reasserted itself. In time, he came to feel that even the meaningless and the evil in his own age (and in Christophe we can see Rolland passing judgment upon his society) had its own significance, which he must discover and welcome and put into art. His intellectual task was not to find that ideal in terms of which a society is to be judged, but to find those ideal meanings into which existing orders can be made to rise—now, in art, and, for the future, in plans which improve things at definite, concrete points.

I hesitate to generalize. Yet does it not seem that the artist seeks to discover meaning in life, while the philosopher seeks to apply meaning to life? For both, the final source of meaning is actual experience; but the philosopher's task is mainly critical, the artist's creative. Need this dichotomy be? If it is the business of philosophy, as tradition has always said, to interpret the whole to the part, then is not Rolland rather than Plato the true social philosopher? Should we not be distrustful as philosophers of any definition of the social object which proposes to find the meaning of existing facts in some ideal order, itself built out of selected facts? Should we not on general principles be critical of any given set of social values which arrogates one type of living above all others? Should not our scientific job be the formulation of that abstract structure or skeleton upon which any society must be built, which any society does actually take, no matter what values it may choose to exemplify or to neglect? Should not our philosophical task be to justify the ways of men to God, by symbolizing them on the level of their intensest and most significant expression?

I am not sure. For, after all, the meaning which an artist is able to discover in an existing order is a finished one; and an evaluation which stops there, stops short just where implications and inferences begin to be really important. The rich meaning which ends realized can have, I, least of all, shall deny. There is a lifetime of living in them; insight deepens, the joy enlarges. But the circle of experience is closed; the meaning can not rise above its completeness. To confine philosophy to the understanding of the historian and the appreciation of the artist, for whom each age has its own significance and that is all, is to cripple philosophy for its most serious enterprise.

For philosophy has to do with the concrete flow of life from structure to structure. It is the one device of nature's giving by which

the direction of that flow may be divined, and perhaps influenced. Its very essence is to enlist the authority of experience, past and present, for dreams and projects which experience itself would never suggest, were it not for the restless, ever dissatisfied hunger of man in his imagination for what is better. So, illegitimate processes of reasoning are the heart of philosophical thinking. We discover new scientific realms of experience by begging the question; we raise new social structures by the same process. Shoot Plato through and through with logical holes, till *The Republic* has not a leg left to stand upon. Still he remains; not for the fustian Utopia which he produced (in irony, perhaps) but for the leverage upon the future of society which his clear vision of one important way of life gave to men. If I am to remain a philosopher, I am afraid I shall have to follow in his footsteps.

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BOOK REVIEWS

The Adventure of Science. BENJAMIN GINZBURG. New York: Simon and Schuster. 1930. Pp. xvi + 487.

The substance of this book was delivered as a course of lectures at the New School for Social Research in New York City. It contains an enthusiastic and, in the main, a very well-written account of the principal achievements of scientific investigators, both ancient and modern, in all fields except psychology and the social sciences. The method of treatment is biographical, successive chapters being devoted to Pythagoras, Aristotle, Archimedes and Ptolemy, Copernicus, Galileo, Harvey, Newton, Lavoisier, Dalton, Faraday and Maxwell, Helmholtz, Lamarck and Darwin, Pasteur, Mendel, and Einstein. The last chapter gives an account of the Atom and the Quantum Theory. Eight of the chapters are accompanied by pictures of the heroes whose work they describe. Diagrams are helpfully employed in explaining the Pythagorean number theory, the Alexandrian eccentrics and epicycles, and the Michelson-Morley experiment. The book is well printed on excellent paper.

The merely casual reader may be tempted to pronounce Mr. Ginzburg's story of science an oft-told tale; for the narrative includes little or nothing which has not been discussed by other popular and semi-popular writers. But a more careful examination will show that the work is much more than another compendium of the sciences. Mr. Ginzburg's dominant interest is philosophical, and he has an epistemological point of view which—whether or not we can regard it as finally satisfactory—so colors the account of each

of his scientific heroes as to impart a surprising degree of coherence to what might have been a mere succession of biographical chapters.

Mr. Ginzburg's fundamental thesis is that science is one of the arts. This is not to be understood as a denial of scientific objectivity, but rather as a protest against the view that the arts are content with mere subjectivity while science seeks objective truth. The author holds that none of the arts is purely subjective, and "what science actually accomplishes is not the abolition of subjectivity but its disciplining in very high degree" (p. xiii). In short, we are asked to consider science, not as an impersonal assemblage of laws and principles, but as a form of human activity; not as science *made,* but as *science in the making.*

It is obvious that this approach to modern science has many decided advantages; but when Mr. Ginzburg goes on to remark that "impersonal science is an abstraction" (p. xiv), the reader may well question whether the assemblage of data quite justifies the assertion. Indeed one gathers from Mr. Ginzburg's own narrative that the so-called "Mendelian laws" would have been discovered even if Mendel had never lived; that the accumulation of geological and biological facts would have necessitated the acceptance of the evolutionary point of view if there had never been a Darwin. And one has a feeling that much the same could be said about the discovery of the true nature of combustion, the laws of motion, the shapes of the planetary orbits, and most of the other outstanding achievements of the sciences. Mr. Ginzburg's account of Archimedes strikingly illustrates the truth that fruitful scientific research requires a community of workers rather than one supremely great man. And, in general, much could be said for the thesis that science is the work of mankind rather than of men. Even if we insist upon personalizing our history of science, we should remember that our justification for doing so is pedagogical rather than scientific. The hero-worshiper needs to be reminded that heroes are often made by the accident of favorable publicity; and that the actual difference between the great and the near-great is much smaller than their relative fame would lead us to suppose. History and biography would no doubt stand nearer to fiction in an objectivity-subjectivity scale than to chemistry, physics, or astronomy.

Mr. Ginzburg, I suspect, would concede most of this. He does not seem to take his biographical facts very seriously, and has been at no pains to document his narrative. His chief concern has been to dramatize his tale by using men of established fame as symbols for various phases and periods of the scientific adventure.

Mr. Ginzburg seems to be especially competent in handling the mathematical sciences. His supreme heroes are Pythagoras, Archimedes, Newton, Maxwell, and Einstein. The key to the understand-

ing of Plato and Aristotle is found in their attitude toward mathematics. In the account of his mathematical heroes, the author displays, at times, a most engaging enthusiasm. Thus the Pythagorean correlation of musical intervals with mathematical ratios is acclaimed as the "greatest scientific discovery that has ever been made" (p. 8). And in the discussion of the relativity theory we are told that "the feeble ray of starlight next to the darkened sun, which by its bending verified Einstein's invariant equations, symbolized the immanent objective order of the universe" (p. 384); for Einstein's theories "have consolidated practically the whole of physics (exclusive of the problem of the atom) into a single system. . . . They show us that scientific giants do not exist only in history, but also right in our own time" (p. 425).

It is a little surprising, however, that Mr. Ginzburg should recite the "story of the two twins" as an illustration of the relativity of time and space measurements (p. 405). It will be remembered that one member of this celebrated pair traveled to Sirius and back again, while the other—like the little pig of the nursery rhyme—stayed at home. The stay-at-home brother had lived forty years by the time his mate returned; but both the clock and the "biological processes" of the traveler had been "slowed up" with the result that *he* had been gone only twenty years! Now it is hard to see how this can be regarded as an illustration of Einsteinian relativity. For if A is moving with speed x with respect to B, all consistent relativists must agree that it is equally true to say that B is moving with speed x with respect to A; and if A's biological processes have been slowed up with respect to B, it must be equally true that B's biological processes have been slowed up with respect to A.[1]

Mr. Ginzburg fails to see this difficulty; for he continues, "On the basis of the Michelson-Morley experiment, the facts of the story are those which science must predict and which must be verified if the experiment could be performed under set conditions" (p. 406). It is obvious, however, that this remark implies what Mr. Ginzburg has called "the Lorentzian explanation of the Michelson-Morley experiment" (p. 400) rather than that of Einstein. For if it were possible to observe a slowing up of the biological processes of the traveling twin, this would amount to a determination of absolute motion. But the principle of relativity is equivalent to the assumption that "it is of necessity impossible to determine absolute motion by any experiment whatsoever."[2]

This suggests certain questions concerning the "general" theory

[1] *Cf.* Professor Lovejoy's articles in the *Philosophical Review*, 1931, pp. 48–68 and 152–167.

[2] Jeans, J. H., *Encyclopedia Britannica*, Thirteenth Edition, article on Relativity.

of relativity. Have not its popular expounders been singularly forgetful of the fact that when one body is suddenly accelerated with respect to another only one of them experiences the jolt;[3] or when one body is made to rotate with respect to another only one of them is subject to the stresses produced by this rotation (or revolution)? And how can Mr. Ginzburg say (p. 417) that it is now "a matter of indifference whether we regard the sun in motion and the earth at rest, or *vice versa*"? For according to the relativistic explanation the motion of each of these bodies is determined by the curvature of the space (or space-time) in which it moves, which in turn depends upon the quantity of matter in or near the region in question. Is it then a "matter of indifference" whether we say that the mass of the sun is 330,000 times that of the earth or that the mass of the earth is 330,000 times that of the sun? Surely, this would be relativity with a vengeance!

To his credit be it said, Mr. Ginzburg has portrayed Einstein as a man, and not as a super-thinker who has a perfect understanding of all things,—including some which must remain forever extremely puzzling to the common herd of cosmologists. Mr. Ginzburg has not advocated any such esoteric mathematicism; for he has made a valiant attempt to translate the mysteries into ordinary speech. All I have meant to urge by way of criticism is that in a few places he has somewhat uncritically repeated the questionable statements of certain other popular and semi-popular expositors. However, he does not attempt to draw any theological or ethical conclusions from the theory of relativity, but remarks (p. 425) that "The connection between relativity in physics and relativity in morals is largely a verbal pun." In the discussion of the quantum theory, too, the author is to be commended for his refusal to follow Eddington in drawing radical epistemological and theological inferences from the principle of indeterminacy.

It must be admitted, however, that this chapter on the quantum theory is somewhat less successful than most of the earlier chapters of the book. It is, indeed, a heavy and difficult discussion, partly perhaps because the author has not succeeded in relating it to any outstanding personality.

The chapter on evolution is well written, and the life and work of both Lamarck and Darwin are sympathetically described; but the presentation is nevertheless curiously biased and incomplete. Strangely enough, there is no reference to recent work on artificially induced mutations—no reference, indeed, to mutations of any kind! This is the more remarkable in that the problem of explaining the occurrence of variations is made one of the principal

[3] *Cf.* Mackaye, James, *The Dynamic Universe*, pp. 257 ff.

counts in the argument against Darwinism. And it is hard to resist the suggestion that the oversight has some connection with the author's anti-Darwinian and pro-Lamarckian polemic. For in view of the fact that mutations do not seem to occur any more frequently in the direction of better adaptation than in that of worse, the mutationist is obliged to fall back upon the concept of natural selection to explain such adaptedness to environmental conditions as actually obtains.

As we have already remarked, Mr. Ginzburg's fundamental thesis is that science is one of the arts. There is then a sense in which the body of doctrine resulting from scientific inquiry, instead of being an exact or complete copy of reality, is a human creation. Science, says Mr. Ginzburg, can not be pictured "as a quest for the eternal laws of the universe" (p. 455). On the other hand, it should not be regarded as "a purely subjective activity," having no correspondence with reality (p. 457). "The structure of scientific theories corresponds to something in the nature of reality without being a complete copy of that reality" (p. 458). "It is through the lead of such an idea," continues Mr. Ginzburg, "that we can properly reconcile the truth of natural science with the truth of ethics and other values." This reconciliation is to be attained through the recognition that science is able to deal with the universe only in so far as it is static, and that for this reason the scientific model of the universe can never exhaust the nature of reality.

It is, however, by no means clear that any such "reconciliation" is required. It is not clear that a static universe would necessarily be hostile to values; for as Mr. Ginzburg uses the adjective, it is obvious that reality may change and change and still be "static." It is true that science postulates permanence; it assumes that what has been will be. But this does not mean that reality is supposed to be literally unchanging. Even if reality is constantly flowing, it may nevertheless be possible to discover routines, to formulate laws which describe the ways in which the flow takes place. And if the laws themselves are found to change, science may look for laws of a higher order in accordance with which these changes take place. But if at any level, however remote, laws should be discovered which are not themselves subject to change, these would be "the eternal laws of the universe."

Now it is hard to see why such a universe should be regarded as less favorable to values than a universe which science must be forever unable to "exhaust." I must confess my complete inability to understand why "static" science should be supposed to "rob us of the ability" "to profit by experience and to achieve ideals" (p. 459). Indeterminism may perhaps be the true view of the world;

reality may be fundamentally irrational, or contain non-rational elements or aspects. But in the nature of the case, this doctrine can never be proved; and it is not at all clear that its acceptance is required in the interest of ethics. Much can be said, indeed, for the contrary doctrine, that ethics, like the physical sciences, is possible only in so far as the world is the domain of law.

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Studies in the Eighteenth Century Background of Hume's Empiricism. MARY SHAW KUYPERS. Minneapolis: University of Minnesota Press. 1930. Pp. viii + 140.

Mrs. Kuypers' essays on Hume, written originally as a doctoral dissertation, succeed in making clear to what extent and in what ways Hume's empiricism was a criticism of philosophical tendencies of his century. Hume's chief desire, as Mrs. Kuypers reminds us, was to introduce the experimental method into moral subjects; but his actual accomplishment, measured at least by the force of his influence, was really not in the field of moral subjects at all. Rather his moral interest led him to attack the *a priori* and rationalistic method of dealing with matters of fact and so to become involved in a critique of science. And here it is, particularly in connection with the principle of causation, that his ideas have been historically most important.

Mrs. Kuypers' discussion falls into two main sections (though these are not quite identical with the divisions indicated by her table of contents). One section concerns Hume's relations to seventeenth- and eighteenth-century science. Three difficulties in the scientific thinking of his day were his objects of attack. First, he saw clearly the full sceptical implications of the dualism common to the scientific developments that culminated in Newton and to the philosophical justification of these developments that was formulated by Locke. He at least, though here he seems to stand uniquely apart from the popular mind, realized the inconsistency between affirming that all ideas must be tested by experience and denying that any objects other than ideas are present in experience. Secondly, he accepted Berkeley's insistence that we must not permit scientists to hypostatize force, gravity, inertia, etc., but must view such concepts as formulae of experienced sequences. And unlike Berkeley, whose theological interests restrained him at this point, he went on to inquire in the same spirit into the concept of cause. Thirdly, he held that empiricism does not make possible a quick and easy passage from observed facts to an alleged theological explanation of these facts. If we can not find efficacy in the world immediately about us, it is doubtful whether we can significantly

and legitimately attribute the efficacy of all processes to God. With all these three difficulties Hume was inevitably concerned if he was to show why the rationalistic method of reasoning was inadequate. And so, though he was primarily a moralist in interest and intent, he got into problems of epistemology, metaphysics, and science, and developed a philosophical system that touched every phase of eighteenth-century thought. If his attack on such contentious matters as miracles and particular providence (which he gives as examples of how his method should be applied) led to more immediate controversy than any other of his writings, his general position came to reinforce considerably the sceptical implications of the experimental method for scientific procedure.

The other section of Mrs. Kuypers' discussion deals with Hume's empiricism in the fields of ethics, politics, and historical writing. Hume's ethics has been so often dealt with that there is less of novelty in this chapter. But the treatment of Hume's empiricism in the fields of politics and historical writing contains much material that students of philosophy have not formerly brought into relation with the other parts of Hume's thought. Hume did much to break down the political dogmas that Locke's influence had fastened on the eighteenth century and Bolingbroke's struggle for power had led him to exploit. He contended that justification for any government must be found, not in any alleged origin of the state or any authority outside the immediate social situation, but in the benefits or harm that the government produced. Thus empiricism works out surely to a kind of utilitarianism. This line of criticism, as Mrs. Kuypers interestingly points out, aroused no storm of opposition so long as Hume expressed it in his detached political essays. But when he went on to write his history of England from the same point of view, he became the target for violent attacks. The political parties of the middle of the eighteenth century were not anxious to defend dogmas but to maintain themselves in power. And "a party living upon traditions requires little theoretical justification for itself, but it is certain to have an interpretation of history which it holds to be above criticism" (p. 121). Thus when Hume discussed history, he found himself denounced as a Tory. Mrs. Kuypers argues neatly that the growing conservatism of Hume's political views (which led to revision of the earlier editions of his political essays) was not an abandonment of his empiricism in favor of secretly cherished dogmas. Rather it was due to his empirical sensitiveness to events (like the Wilkes affair in the 1760's) which seemed to him to demand wiser counsel than the populace proved competent to supply.

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An Outline of Social Psychology. J. R. KANTOR. Chicago: Follett Publishing Co. 1929. Pp. vii + 420.

As the author says in the Preface, social psychology is so romantic "that its very identity is an enigma." The books which have actually appeared seem to indicate that the writers decide for themselves, individually, how the enigma shall be solved. Consequently they differ widely, sometimes merely writing a philosophy of social evolution with emphasis on the importance of mind, at other times exploiting the possibilities of pure behaviorism in what they distinguish as social situations. Professor Kantor states that the "central task of the present volume is to present as satisfactory a statement as possible of the psychological facts of social psychology." This is a worthy object if it can be considered sufficiently distinct. But in fact the program is complicated from the beginning by the admission that the facts do not exist alone: "they are always set in a matrix of humanistic events." The result, in brief, seems to be that this writer intends to see how his own concept of organismic psychology can be elaborated in a set of terms which have a social significance. He elects to call this "institutional social psychology."

After making a critical examination of the present conceptions of social psychology, the author develops his theme in four parts. The first part deals with perspectives of social psychology; the second with the data; the third with the relativity of individuals and psychological collectivities; the fourth with some psychological phenomena as aspects of humanistic situations. In this statement we have quoted the author's own words, feeling that this was the safest course. In spite of some intensive study, we have failed to overcome the impression that the book as a whole is an exercise in translating obvious facts into an esoteric language. Emphasis is laid on the point that psychology now avoids psychic states; to be modern it must be objective, and to understand the word "objective" we must refer back to the author's systematic organismic psychology. As an example of matter and method we may quote the following: "One of the most fundamental conceptions of objective psychology is that of rational biography. We recall that this conception refers to the individual's actual development of behavior. Since only responses are psychological facts every element of psychological science is developed in the person's progressive contacts with objects and situations. These interactions constitute his reactional history or biography." With this statement no one will quarrel, but many readers will probably wonder what it exactly achieves. Similarly (p. 217) the fact that there are different dialects in the Anglo-Saxon world is translated into the statement that "each of

these reactional collectivities performs English language responses by using particular modes of English expression."

The early promise of social psychology has, according to Professor Kantor, not been fulfilled. Its progress still seems disappointing. Perhaps this indicates that it is not yet either an art or a science, but a point of view. This age, we are told, is a psychological age, and it wants to restate its anthropology, history, and economics in a language which is at least colored by psychology. Whether the terms and the method which Professor Kantor offers in this book are the best instruments to effect the transformation must be left for the readers to decide.

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JOURNALS AND NEW BOOKS

INTERNATIONAL JOURNAL OF ETHICS. Volume XLII, No. 1. Discussion: The Aim and Content of an Introductory Ethics Course: A Symposium by Seven American Professors: *A. P. Brogan, Clifford Barrett, Robert C. Givler, W. B. Mahan, George Boas, Albert E. Blumberg,* and *Paul E. Johnson.* Index to Volumes I–XLI.

ERKENNTNIS. Band 2, Heft 2–3. Bericht über die 2. Tagung für Erkenntnislehre der exakten Wissenschaften in Königsberg 1930.

Joseph, H. W. B.: Some Problems in Ethics. Oxford: Clarendon Press. 1931. vi + 135 pp.

Ross, W. D.: The Right and the Good. Oxford: Clarendon Press. 1931. vi + 176 pp.

Russell, Bertrand: The Scientific Outlook. New York: W. W. Norton Co. 1931. x + 277 pp. $3.00.

NOTES AND NEWS

We regret to announce the death of Professor Herbert Wildon Carr on July 8th at Los Angeles, after a long and painful illness.

Professor Carr was 74 years old and had been Visiting Professor of Philosophy at the University of Southern California since 1925, and Professor of Philosophy at the University of London since 1918. Among his books are the following: Henri Bergson, 1910; The Problem of Truth, 1911; The Philosophy of Change, 1914; The Philosophy of Benedetto Croce, 1917; The Principle of Relativity, 1920; The Theory of Monads, 1931; The Scientific Approach to Philosophy, 1924; Changing Backgrounds in Religion and Ethics, 1927; The Unique States of Man, 1928; The Freewill Problem, 1928; Leibniz, 1929; Cogitans Cogitata, 1930.